would prevent the application of this theory to the great lakes of North America. It is a singular fact, however, that whilst both these Crustaceans have been discovered in Lake Superior and also in Lake Michigan, only one of them has been found in Lake Ontario, the *Mysis* seeming to be wholly wanting.

XLIII.—*On the Structure of the Echinoidea.* By S. Lovén*.

[Plate XIV.]

Besides the well-known external organs, ocelli, spines, pedicellariæ, the clavulæ of the fasciole, tentacles, and branchiæ, the recent Echinoidea possess another kind of organs which have hitherto been overlooked, although they occur so generally that we seek them in vain only in *Cidaris*. These are very small, button-like bodies, spheroidal, ellipsoidal, or somewhat irregular balls, 0·11–0·375 millim. in their greatest diameter, furnished with a short stalk, which is movably attached to a small, slightly projecting tubercle. They may not unsuitably be named *sphæridia*. They are hyaline, shining, hard, solid, and clothed with connective tissue rich in pigment, with epithelium and a ciliated cuticle. Their pedicel has the reticulated texture typical of the Echinoidea, which spreads more or less distinctly and continuously around its starting-point. In the direction of the axis of the ball we not unfrequently see a tube which opens in its upper pole, and is either simple or branched in a more or less regular manner. A great many of the balls have on their surface small elevations, tubercles, or spines—and many also depressions, which are sometimes shallow, but sometimes sink deeply in, towards the axis, in a conical form. But the greater part of the mass of the ball is formed of very numerous and very thin concentric layers; and there are some which do not present any thing but these. Their solid contents are dissolved by a weak acid, so that only the epithelium remains.

The sphæridia belong exclusively to the ambulacra (radii); and in all the genera which possess them they are never wanting on the peristomial plates, but differ in number and distribution in a direction from the mouth. They always occupy a definite position. In the Spatangidæ they stand, generally uncovered, one, two, or more in a little group, by the base of the tentacular cirri of the buccal area, near the side turned towards the median suture of the ambulacra, decreasing thence the further from the mouth, especially on the bivium,—not unfrequently four, three, or two upon each of the first plates, only one upon each of the immediately following ordinary plates, in *Plagionotus*, *Brissus*, *Schizaster*, and *Mæra* (*Gualteria*?), more numerous on the bivium, in depressions, or like rows of beads in narrow, elongated, well-defined furrows; but in *Lovenia* the segregated sphæridia are concealed under domes, which have a small, narrow, transverse opening at their apex.

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* Translated by W. S. Dallas, F.L.S., from a separate copy communicated by the author, from the 'Œfversigt af Kongl. Vetenskaps-Akad. Förhandlingar,' 1871, no. 7.

A covering of this kind, which is an exception among the Spantangidæ, is the rule in the Cassidulidæ and Clypeastridæ. *Rhyncholampas caribæarum* (Lamk.), *Pygorrhynchus pacificus* (Agass.), and many others have on every plate of the first five pairs in each ambulacrum a sphæridium, which is gradually overgrown by the outer layer of the shell-substance, which finally leaves only a fine fissure open.

The Clypeastridæ exhibit two types. *Echinarachnius*, *Dendraster*, *Lobophora*, *Mellita*, *Encope*, *Rotula*, *Laganum*, *Scaphechinus*, and *Echinocyamus* have in each radius only a single sphæridium in common for both its peristomial plates, and most frequently, even in very young individuals, concealed in a crypt in the mass of the shell. Near the peristomial margin, which in the middle has a part somewhat projecting over the two large pores of the buccal tentacles, we see, behind this, a small, more or less distinctly halved elevation. On breaking this up we find a sphæridium with its pedicel attached to the inner surface of a rounded cavity towards the mouth, which is connected with the exterior either only by a fine canal, or, in *Rotula*, by means of a tolerably wide opening, which is in part covered by points projecting from its margin. In *Echinarachnius* this cavity is divided into two halves by a very thin, vertical membrane, which seems to issue from the edges of the plate united in the suture. It is otherwise with *Clypeaster* and *Arachnoides*; these have two sphæridia in each ambulacrum, one in each of its two peristomial plates. In both, the margins are destitute of the projecting part, and the two pores of the large tentacles are exposed, not, as in the preceding, in a surface falling abruptly towards the mouth, but in a more level and open surface which nowhere exhibits a sign of the presence of the sphæridium. In *Clypeaster* we can only perceive that, at a distance from the tentacular pores twice that of the latter from the margin, the large radial tubercles have between them a greater space than elsewhere, but not differing in the disposition of the small tubercles and pores. If we break through the outermost layer of the shell, we find in both plates a small cavity, and in this a sphæridium, placed as in the preceding. In the broad, perfectly smooth furrow which in *Arachnoides* occupies the middle of each ambulacrum, nothing indicates the position of the sphæridia; but we find them concealed in the shell at the same distance from the pores as in *Clypeaster*.

Echinoneus has, near the tentacular pores on the first and second plates, segregated globular sphæridia, which are seated uncovered in slight depressions. In this, as in much else, it resembles the regular Echinoidea.

In most of the latter the sphæridia are numerous and distributed alternately on both rows of plates of the ambulacra. *Echinus Flemingi*, *E. esculentus*, *Toxopneustes dröbachensis*, *Loxechinus albus*, *Tripneustes ventricosus*, *Echinometra lucunter*, and *Amblypneustes ovum* have their usually ellipsoidal sphæridia arranged near the sutures, with the long axes nearly parallel to the surface of the test. In *Temnopleurus*, *Salmacis*, and *Mespilia* their form is spheroidal, and they stand in the apertures of the deep cavities in the angles of the plates. In all these Echinidæ the row of sphæridia is separated on both sides from the tentacular pores by the series of large radiolar tubercles. In *Diadema*, on the contrary (*Astropyga*), the sphæridia are seated near the tentacular pores, and the radiolar series of tubercles is situated between them and the suture. *Echinocidaris* is quite different, as it has in each ambulacrum only a single sphæridium in a rounded notch in the suture quite close to the margin. In *Cidaris* sphæridia are not found.

These organs, which are so well and peculiarly protected in many genera (*Brissopsis lyrifera* seems to protect its uncovered sphæridia by binding together the neighbouring small radioli over them), cannot be any thing but a sensorial apparatus, probably destined for the perception of the changes which take place in the surrounding water and in the substances which this holds in solution or suspension, consequently an organ of taste. *Brissopsis lyrifera* holds them quite still for hours; then follows a half-circular movement around the point of attachment, which very soon ceases. The strong nervous stem which runs internally along the suture in each ambulacrum gives off alternate branches, one for each plate. Every such branch enters with the tentacular vessel into the pore of the plate, and passes through this out to the outer side of the test; in this way it may furnish both tentacles and sphæridia with nerves, although I have not succeeded in demonstrating this. It is easier, in *Brissopsis lyrifera*, especially in the bivium, to ascertain how the nerve, after issuing through the pore, loses itself on the outside of the calcareous layer, beneath the overlying connective tissue, in a great number of branches, which run through the anterior part of the plate in a radiating and diagonal direction in order to distribute themselves to the interradial radioli and other external parts attached to the plate. This branching is most distinctly seen on the third plate of the bivium situated near the sternum, which is freer from spines than the second.

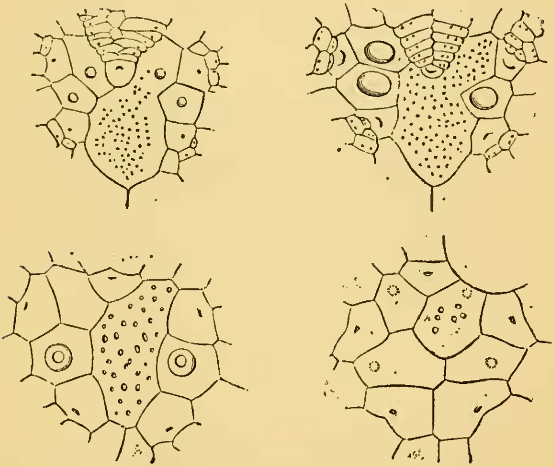
The sphæridia make their appearance, seemingly, later than the spines and pedicellariæ in very young Spatangidæ (*Brissopsis lyrifera*, *Echinocardium ovatum*), first one alone in the single peristomial plate of the ambulacra, then one on the second plate, and so forth; all in accordance with the order which prevails in the disposition of the ambulacral plates throughout the whole class, and which, at least in all recent Echinoidea, may be expressed by a formula common to all. This order is as follows:—

If we hold a *Spatangus* of any species with the mouth turned upwards and the unpaired interradium backwards, and count the ten peristomial plates of the ambulacra going from left to right (that is to say, from the animal's right to its left side) round the buccal aperture of the test, marking, in each of the ambulacra I., II., III., IV., V., the plate we first come to with the letter *a*, and the second with *b*, we shall find that the plates I. *a*, II. *a*, III. *b*, IV. *a*, V. *b* are larger and bear two pores and two tentacles, whilst I. *b*, II. *b*, III. *a*, IV. *b*, and V. *a* are smaller and furnished with only one pore and one tentacle. Assuming that here each ambulacral plate has originally only one tentacle and one pore, the former series of plates should consequently, although no suture can be detected, be composite and binary, and the latter simple and primary, like all the other ambulacral plates. The *Cassidulidæ* behave in exactly the same manner; in the binary plates one of the pores is situated in the outer horn of the plate. That in the *Clypeastridæ* the peristomial plates of the ambulacra follow the same rule is seen from their unequal size—I. *a*, II. *a*, III. *b*, IV. *a*, and V. *b* being larger than I. *b*, II. *b*, III. *a*, IV. *b*, and V. *a*; and *Clypeaster rosaceus* has in the smaller plates one, and in the larger ones two tentacular pores, which differ by their size from the numerous pores for locomotor tentacles. If an *Echinoneus* be held in the above-mentioned position and counted in the same manner, the same arrangement is manifest. The peristomial plates I. *a*, II. *a*, III. *b*, IV. *a*, and V. *b* are larger and have two pores, a complete double pore and one which is marginal and half interrupted; I. *b*, II. *b*, III. *a*, IV. *b*, and V. *a*, on the contrary, are smaller and bear only one double pore.

Thus in the irregular Echinoidea the peristome of the trivium is asymmetrical with relation to the antero-posterior axis; of its six ambulacral plates, the right side of the animal has two simple and one binary, and the left side two binary and one simple. The bivium, on the contrary, includes symmetrically the unpaired interradium. Right and left are determined here by the position of the anal aperture, and also, except in the *Clypeastridæ*, by that of the madreporic plate; in the regular Echinoidea, hitherto, by the latter alone.

Of the five genital plates, the *Spatangidæ* are destitute of the hinder one, which elsewhere is placed near the end of the unpaired, anal interradium. It has never been developed, any more than the genital gland, which otherwise, as in the four others, should have its efferent duct through it. In all the known living *Spatangidæ*, apparently with the exception of a single genus, its place is occupied by the madreporic plate; the filtering-apparatus of the aquiferous system, which spreads itself out in the posterior part of the vertex, often occupies a greater space than any of the four genital plates, is posteriorly in immediate contact with the last plates of the anal interradium, by which it is enclosed, and separates from each other the eye-plates of the bivium and the lateral genital plates. There is no suture to form a boundary between the right anterior genital plate and the madreporic area; and when the latter has a great extension it is this plate that first enters into

Fig. 1.



Echinocardium cordatum (Penn.), *Schizaster fragilis* (Düb. & Kor.),
Abatus Philippii, n., *Hemiaster expergitus*, n.

it:—in some to a small extent, as in *Meoma ventricosa*; in others, *e. g. Brissopsis*, to a greater extent; and in some, *e.g. Schizaster fragilis* (Düb. & Kor.), so completely that the genital pore is absent, and with it the right anterior interradial genital gland. The next in order to disappear are the genital pore and gland of the left anterior genital plate; and when, as in *Abatus Philippii*, n., and *Palæostoma mirabile*, Gray, only two genital pores remain, these are situated in the lateral genital plates. An arrangement by which the madreporic plate extended backward separates from each other the eye-plates of the bivium, occurs among the *Spatangidæ* of the Eocene period, and not only in most of those which also belong to recent times, but also in some (*e. g. Prenaster, Macropneustes*) which had already made their appearance in the younger deposits of the Cretaceous formation. On the other hand the genera which essentially belong to the latter formation and attained in it their highest development, present throughout a different disposition of the genital and madreporic plates, at the same time that the latter does not reach the posterior interradium, but is separated from it by the eye-plates of the bivium, which meet and touch each other, as do also, in most, the lateral genital plates. Among the known living *Spatangidæ* only one has this character of antiquity, namely *Hemiaster expergitus*, n., which was discovered on the voyage of the Swedish corvette 'Josephine,' in the year 1869, by Smitt and Ljungman, near Josephina's bank, in 38° 7′ N. lat. and 9° 18′ W. long., at a depth of 550 fathoms on a clay bottom. The genus, which until then was regarded as having become extinct during the Miocene Tertiary period, and which attained its highest development during the Cretaceous period, is recognized by its rounded oval outline, which, with a length of 14 millims., has a breadth of 13 millims., by its posteriorly considerable height (10 millims.), by the position of the periproctium high up on the posterior surface, the single peripetalous broad fasciola, which forms an oval ring, the short, broad petala of the bivium half as long as the anterior ones, and, for still further distinction from *Abatus*, by the madreporic plate with which the anterior right genital plate is united, but which posteriorly does not reach the unpaired interradium, but is shut off from it by the two eye-plates of the bivium and the lateral genital plates. The individual is young, so that the four genital pores do not yet perforate the genital plates, and the madreporic plate has only a few pores; but the peristome is reniform, and the lobes prominent. The ambulacra are remarkably narrow where they pass under the fasciola. The test is extremely thin and brittle.

In the regular Echinoidea the anus opens in the circle formed by the genital and eye-plates perpendicularly above the mouth, and the corona, which is nowhere in contact with it, developes in like manner its ambulacra and interradia. The apparently regularly radiate form is originally disturbed by the madreporic apparatus, which perforates with its strainer one of the genital plates, all of which subsequently, during the early growth of the animal, become perforated by the efferent ducts of the genital glands. That even here the genital plate which contains the madreporic plate is the right anterior one, and that the ideal longitudinal axis of the body passes through the unpaired ambulacrum, as thereby indicated, is confirmed by the fact, that only by such a division between right and left does the same formula prevail for the plates of the peristomial margin in the regular as in the irregular forms. This is most distinctly observed in very young individuals, in which the primary plates may still be distinguished.

If a young *Toxopneustes dröbachensis* of from 3 to 6 millims. diameter be held with the mouth upwards, and the unpaired ambulacrum, determined as above, forwards, and the peristomial plates be gone through in the same sequence as was adopted in the examination of the irregular Echinoidea, we find not only that all the peristomial plates are composite (and may therefore be denominated large plates), but also that I. *a*, II. *a*, III. *b*, IV. *a*, V. *b* are all ternary; that is to say, every one of them consists of three still distinguishable primary plates; whilst I. *b*, II. *b*, III. *a*, IV. *b*, V. *a* are binary, formed of two primary plates. Consequently here also the peristomial plates of series I. *a*–V. *b* are larger than those of series I. *b*–V. *a*, and likewise bear more pores. In both series, the first primary plate has two pores, a complete double pore and one which is formed only by a notch in the very margin; and it may be supposed that this primary plate is a combination of two plates which were distinct in a still younger stage, the earliest formed of which, like all others, had a complete double pore, which afterwards, during growth, shifted to the margin and became reduced, its upper passage being closed and its lower one partly removed and thus converted into merely a notch of greater or less depth (see Plate XIV. figs. 1 & 2–8).

The primary ambulacral plates in the Latistellæ are in part entire, *i. e.* such as occupy the whole space between the interradium and the median suture of the ambulacrum, and in part halved, or such as extend from the interradium to about the middle of the entire ones, and terminate there in a more or less distinct point. The larger peristomial plates of the ambulacral series I. *a*–V. *b* generally consist, in very young individuals, of an entire adoral, a half intermediate, and an entire aboral primary plate; but sometimes all three are entire; in series I. *b*–V. *a* both primary plates are always entire.

The order which prevails in the ambulacra at the peristome recurs at the vertex. The corona of a young *Toxopneustes dröbachensis* of 4 millims. diameter, and with a stoma of 2·4 millims. is shown by the proportions given in the following table, which states for each large plate the number of its primary plates, of which the half ones are included in parentheses:—

	Large plates:—	1	2	3	4	5	6	7
of series I. *a*–V. *b*.	I. *a* . .	1 (2) 3	1 (2) 3	1 (2, 3) 4	1 (2, 3, 4) 5	1 (2, 3, 4) 5	1 (2)	
	II. *a*. .	”	”	”	1 (2, 3) 4	”	1 (2, 3, 4)	
	III. *b*	”	”	”	1 (2, 3) 4	”	1 (2, 3, 4)	
	IV. *a*	”	”	1 (2, 3) 4	1 (2, 3) 4	”	1 (2, 3, 4)	
	V. *b*. .	”	”	1 (2, 3) 4	1 (2, 3, 4) 5	”	1 (2)	
of series I. *b*–V. *a*.	I. *b* . .	1, 2	1 (2) 3	1 (2, 3) 4	1 (2, 3) 4	1 (2, 3, 4) 5	1 (2, 3, 4) 5	0
	II. *b*. .	”	”	”	”	”	”	1
	III. *a*	”	”	”	”	”	”	1, 2
	IV. *b*	”	”	”	”	”	”	1
	V. *a*. .	”	”	”	”	”	”	1

It will be seen that the number of primary plates in each large plate increases from the peristome towards the vertex. In the rows of series I. *a*–V. *b* this increase is not quite regular, but somewhat unequal in the large plates 3 and 4, which may be an individual peculiarity; but the rows I. *a*–V. *b* of the bivium agree perfectly, even in the last plates, where the trivium also forms a group of similarly developed plates. In series I. *b*–V. *a*, however, the increase is the same throughout. In large plate 3 some individuals have 1 (2) 3.

In each row the peristomial plate 1 is the oldest; the other plates are younger in proportion as they are further from this; and the youngest is that which strikes upon the eye-plate of the vertex. The youngest plate has not the same ordinal number in the rows of both series. In the rows of series I. *a*–V. *b* it is the sixth, in those of series I. *b*–V. *a* the seventh, with the, perhaps, individual exception of I. *b*; so that this series, which in the peristome has one primary plate less than series I. *a*–V. *b*, has in its increasing end one or several more than this, inasmuch as not only is the large plate 6 completed, but even the large plate 7 is commenced.

Each large plate commences as follows:—Close to the aboral margin of a previously completed large plate the new first primary plate is formed, close to this the second, and so on.

All primary plates, even the half ones, are originally in their first foundation entire plates; that is to say, they reach from the interradium to the median suture of the ambulacrum. Subsequently, whilst the whole of the complex of primary plates which forms large plates increases in breadth, and even before it is completed by the last primary plates, the intermediate ones fall off in their growth; and whilst they retain their position in the boundary of the ambulacrum towards the interradium, their narrowed ends become more remote from the median suture of the former. The first formed of these intermediate plates is the smallest of all, the later ones become gradually larger; and thus it happens that whole groups of intermediate primary plates acquire forms of a triangular figure, the apex of which is formed near the middle of the large plate by the projecting end of the last alone. By all this it is also clear that these intermediate plates are not of later origin, neither secondary nor inserted, but that they are formed in ordinal sequence with the two outer entire plates. But the latter grow to a much greater degree, so that they directly touch each other where the intermediate plates cease, constitute the greatest part of the area of the large plate, and the whole of its margin towards the median suture.

The youngest large plates are distinctly longer, in the direction from the vertex towards the peristome, than broad; but in proportion as each large plate grows, and at the same time is removed from the vertex, it becomes broader in proportion to its length. The greatest periphery of the corona is always so placed that half the number of the plates and something more is ventral—that is to say, situated between it and the peristome, notwithstanding that the distance from it to the peristome is always less than to the vertical rings. Consequently during growth a compression from above downwards of the ventral plates takes place, which appears more strongly in proportion to their age, and, in combination with the movement which also takes place in each large plate, alters their form in a regular manner and at the same time changes the position of the pores. In the youngest individuals which have been examined, all the tentacular pores (with the exception of the very first interrupted one) are placed near the suture towards the interradium, and those which belong to the same large plate form together a curve with a slight, outwardly convex flexure. These are the primordial pore-arcs. But the tentacular pores begin very soon to move, in order to take up a different position, and finally form other secondary arcs, which remain the same during the animal's whole life, and are so characteristic that we derive from them the characters of the genera. What determines the issue of this removal is that the pores of the entire plates have, even in comparison with the size of the plates, a greater movement than those of the half plates. Every pore which belongs to an entire primary plate departs by degrees from its margin and approaches the middle. Within every large plate this movement is strongest in the first, adoral primary plate, and combined with a drawing downwards; in the last, aboral primary plate the same movement occurs, although in a less degree. In the intermediate half plates the shifting of the pores is nothing or almost imperceptible in the first, but more considerable and increasing in the following ones. Consequently, if a large plate is composed of a first entire primary plate, (1), three intermediate plates, (2, 3, 4), and again an entire plate, (5), the first pore moves far inwards nearly to the middle of the plate, the second retains its original position, the third has drawn itself a very little inwards, the fourth rather more, and the fifth still more. But it is a consequence of this unequal movement that the first pore no longer belongs to the original pore-arc, but has separated therefrom and entered and completed a new, secondary arc, the other members of which are constituted by the pores of the preceding large plate, with the exception of the first. The arcs of 3, 4, 5, 6, or 7 pores which characterize *Toxopneustes*, and in which the number of pores is dependent on the number of intermediate plates, are therefore always counted from and including the second pore in one large plate, to and including the first in the following plate. These alterations of the ambulacra are represented in Pl. XIV. figs. 2–8.

In the peristome, even in individuals of small size, all order seems to have disappeared in consequence of these shiftings. This, however, is only apparently the case. A careful examination shows that every thing arranges itself in accordance with the same law.

The peristomial plates of series I. *a*–V. *b* present the following alterations. The rudimentary double pore (1), which remains only as a notch in the very margin, moves gradually past the middle of the first plate and becomes still more inconsiderable; for whilst the corona grows near its vertical pole, some of its solid substance disappears in the margin of the peristome, where its calcaceous deposit is slowly absorbed, with the result that the pore-cup which was moving thither becomes, as it were, eaten away, and loses a greater or less portion of its wall. The perfect double pore (2) in the first primary plate (1, ɪ), which is an entire plate, moves, like this, from the suture towards the middle, and also approaches the margin, so that by degrees it loses a good deal of the wall round its lower aperture, after the upper one becomes filled up and blind. These two pores (1 and 2) form persistently a pair of themselves. The second primary plate (1, 2) is a half plate; its pore (3) removes very slightly from its original place, and commences the first distinct secondary arc, but, in consequence of the diminution and depression of the first primary plate, approaches the margin, where it also in its turn loses a part of its wall. The third and last primary plate (1, 3) of the first large plate is again an entire plate; and its pore (4) also moves inwards, and further than the preceding one. Pore 5, which belongs to the first primary plate of the second large plate, is, as such, again the most movable, wanders far from the suture, and completes the first secondary arc of the three pores 3, 4, 5. Pore 6, situated in the intermediate half plate 2, 2, remains in its place as the first of the second arc, again of three pores, of which the second, (7), in primary plate 2, 3, has moved inwards not inconsiderably, although not so much as the third (pore 8), which belongs to primary plate 3, 1. With pore 9, in primary plate 3, 2, again commences a third secondary arc of four pores, which move in accordance with the same law as the preceding ones—namely, 9, pl. 3, 2, 10, pl. 3, 3, 11, pl. 3, 4, and 12, pl. 4, 1. Whilst these movements have been going on, the large plates 1, 2, and 3 have also become more strongly compressed. In one individual (fig. 2) they constitute two thirds of the whole height of the corona, and the greatest periphery nearly coincides with the suture between 2 and 3; in fig. 3 they all lie below the line of the greatest periphery, occupy less than half the height of the corona, and their width is rather greater than their height. The first large plate (1), the peristomial plate, especially, is strongly compressed; its pores cease to grow; their upper tube is diminished or closed; pore 2 loses still more of its wall in the margin of the peristome; pore 3 gradually follows in the same direction; the radiolar tubercles disappear entirely or for the most part; and in the individual, fig. 6, the suture between the large plates 1 and 2 has disappeared, and they have coalesced to form a single binary large plate of the second order, 1 + 2, composed of six primary plates, which number cannot be distinguished; and the large radiolar tubercle it bears is that which originally belonged to large plate 2. In the individual, fig. 7, this double large plate 1 + 2 has become still more compressed; of pore 2 only half remains, and but little more of pore 3. The sutures of the primary plates now disappear still more within the large plate 3; and in the individual, fig. 8, even this has completely coalesced with 1 + 2 to form a single ternary plate of the third order, 1 + 2 + 3, composed of eleven primary plates, and consequently furnished with eleven pores, so placed that they may be counted as follows:—1, 2; 3, 4, 5; 6, 7, 8; 9, 10, 11, and, to complete the latter arc, 12 in the following large plate 4,—that is to say, in groups of 2, 3, 3, 4, &c. The form of this large composite plate has now become such that its breadth stands to its height about in the relation of 1 : 0·7. In the youngest specimen (fig. 2), in which the three plates are quite distinct, the breadth is to their length, taken together, as 1 : 2·25.

Within the first coronal plates which belong to series I. *b*–V. *a* corresponding changes take place, with only such differences as are due to the first large plate consisting only of two primary plates. Here, also, the plates 1, 2, and 3 coalesce, apparently almost earlier than in series I. *a*–V. *b*. The ternary plate of the third order finally produced by coalescence has then ten pores so arranged that they may be counted 1, 2; 3, 4; 5, 6, 7; 8, 9, 10, and, to complete the arc, 11 in the next large plate (4); consequently 2, 2, 3, 4, &c. It is by the second number that we recognize the peristomial plates of series I. *b*–V. *a*; it is there two, but three in series I. *a*–V. *b*; and this character is constant in the Latistellæ, which may be oriented by this means. The fourth arc, which here has four pores, has only three in occasional individuals; that is to say, the third large plate has only one intermediate primary plate. Some variability seems to prevail in this.

In the Echinidæ the tentacular pores are double pores. Within an oval space or cup bounded by a more or less elevated wall open two straight passages, through which aquiferous ducts pass to the tentacle. Their openings on the inside of the shell are considerably further apart than on the outside. These passages consequently traverse the thickness of the test in an oblique direction. If we compare the position of the outer apertures with that of the inner ones in the same plate of different ages and sizes, we find that the inner ones do not change their position so much as the outer ones; so that the passages which, in the younger specimens, take the shortest course from the inside to the outside, gradually draw away during growth in an oblique direction towards the middle, in the same proportion as the outer apertures shift their place. The movement which takes place in the substance of the plate is therefore not the same in its whole mass, and has, the nearer we go to the outside, a preponderant direction towards the median suture of the ambulacrum.

Thus, in *Toxopneustes dröbachensis*, do the ambulacra grow, with constant alterations in the plates and pores; but even in the largest individuals the different character of the two different series is recognized by the form aad grouping of the above parts in the peristome. The numbers by which the arrangement of the pores can be indicated in that species (namely, in series I. *a*–V. *b*, 2, 3, 3, 4, &c.; and in series I. *b*–V. *a*, 2, 2, 3, 4) recurs not only in generically allied species, such as *Toxopneustes brevispinosus* and *T. lividus*, but also in *Loxechinus albus*, *Echinus esculentus*, *Lytechinus variegatus*, *Tripneustes ventricosus*, *Boletia heteropora*, *Amblypneustes ovum*, *Temnopleurus toreumaticus*, in fact throughout the Latistellæ, even in the *Echinometræ*. In the arrangement of the pores round the peristome the same numbers recur in the West-Indian *E. lucunter*, Linn., with striking distinctness. The madreporic plate is situated, as in all others, near the right anterior interradium; and the animal's antero-posterior does not coincide, as J. Müller thought he found, with the longest diameter of the oval test; but it is oblique, as L. Agassiz supposed; for the longitudinal diameter passes through ambulacrum I. and the corresponding interradium 3, and in its vertical plane are situated the lines of curvature for the flexure of the test. On the other hand *Heterocentrus* and *Colobocentrus* are symmetrical; in these, moreover, the short diameter of the test is its antero-posterior axis, in which direction also the peristome is elongated, with the posterior sinus deepest. This is the position accepted by J. Müller as the correct one in these genera; but the position which is thus given to the madreporic plate, he regarded as an exception from that which he regarded as the normal one both in *Echinus* and *Cidaris*, near the left posterior interradium. This is not the case. Except in the Clypeastridæ the connexion of the madreporic plate with the right anterior apical plate is constant in all Echinoidea. If its position is occasionally unknown, it is found in the Latistellæ by the formula of the arrangement of the pores in the peristomial plates, and by the antero-posterior axis of the same test, and its division into a trivium and a bivium.

The Latistellæ have ten free pore-plates in the buccal membrane. It might be asked whether these do not become very early detached from the corona, before the auricles are yet developed. Careful investigations under favourable conditions ought to settle this question. A small *Toxopneustes dröbachensis*, 2 millims. in diameter, has already the five pairs of large plates in the buccal membrane, each pair in front of an ambulacrum (fig. 9). Of these ten plates, those of series I. *a*–V. *b* are the larger, but destitute of tentacular pores; the other five, of series I. *b*–V. *a*, on the contrary, are smaller, and each furnished with its pore and its tentacle; that is to say, this latter series is here, as always, inferior in size, but superior in development to the former one. In a much earlier stage (fig. 10), when the young *Echinus*, 0·6 millim. in diameter, no longer shows any remains of its pluteus, but still does not present any indications either of mouth or anus, it moves, as we learn from J. Müller's investigations, by means of five large primordial tentacles furnished with sucking-disks, which issue, at equal distances apart, from inconsiderable depressions not far from the margin of the ventral surface of the lentiform body, which was turned towards the inside of the pluteus. Within these large tentacles is situated a circle of five pairs of calcareous reticulated disks, of a rounded, internally oblong form. Each disk has near its aboral end a large, evenly bounded, oval, outwardly pointed aperture, above which is placed one of the ten smaller tentacles (figs. 12 & 13). These five pairs of disks can hardly be any thing but the foundations of the first primary ambulacral plates, and the rather because, between the pairs nearer to the periphery, five smaller, nearly triangular plates come in, which then would be the first commencement of the interradia. Each of the five large primordial tentacles has its base in the line which separates each pair of the ten smaller and later ones, at the point from which the median suture of the ambulacrum will subsequently start. Can these five isolated tentacles have any thing in common with the tentacles of the buccal membrane, which also first make their appearance isolatedly? Krohn saw them become absorbed and disappear before the mouth opened, and the ten paired tentacles become the instruments of locomotion in their stead*.

[To be continued.]

XLIV.—*Notes on* Propithecus bicolor *and* Rhinoceros lasiotis.

By P. L. Sclater, M.A., Ph.D., F.R.S.

The Lemur described by Dr. Gray in the last Number of the 'Annals' (*anteà*, p. 206), as *Propithecus bicolor*, has been already named *Propithecus Edwardsi* by M. Alfred Grandidier (Compt. Rend. lxxii. p. 231, 27 Feb. 1871). M. Milne-Edwards, who has requested me to make known this correction, informs me that he has examined a marked skin of this animal received from Mr. E. Gerrard, jun., and has no doubt of the identity of the two species.

As regards the two Asiatic two-horned rhinoceroses in the Zoological Society's Gardens, when the first specimen arrived from Chittagong I referred it to *Rhinoceros sumatrensis*, that being the only species of this section then known to science.

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* Müller's Archiv, 1851, p. 351.